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GB 1441818
GB 1365166
GB 1287720
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GB 888685
GB 234278
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(54) Armature windings for direct current machines and apparatus for mounting windings on armatures

(57) Armature windings for direct current machines are made up of individual winding elements (1) which are introduced into slots (11) in an armature (12) (Fig. 4). The winding elements (1) are of meander-shape and are initially inserted (Fig. 3) into a reception part (14) from the inside to the outside in the reverse sequence from that in which they are to be mounted in slots (11) in the armature (12); the reception part (14) and the armature (12) are brought together (Fig. 4), and the elements (1) are then pushed (15) into the associated armature slots (11) as the armature (12) is rotated relatively to the reception part (14). In Fig. 5 (not shown) a reception part (16) is of circular shape.

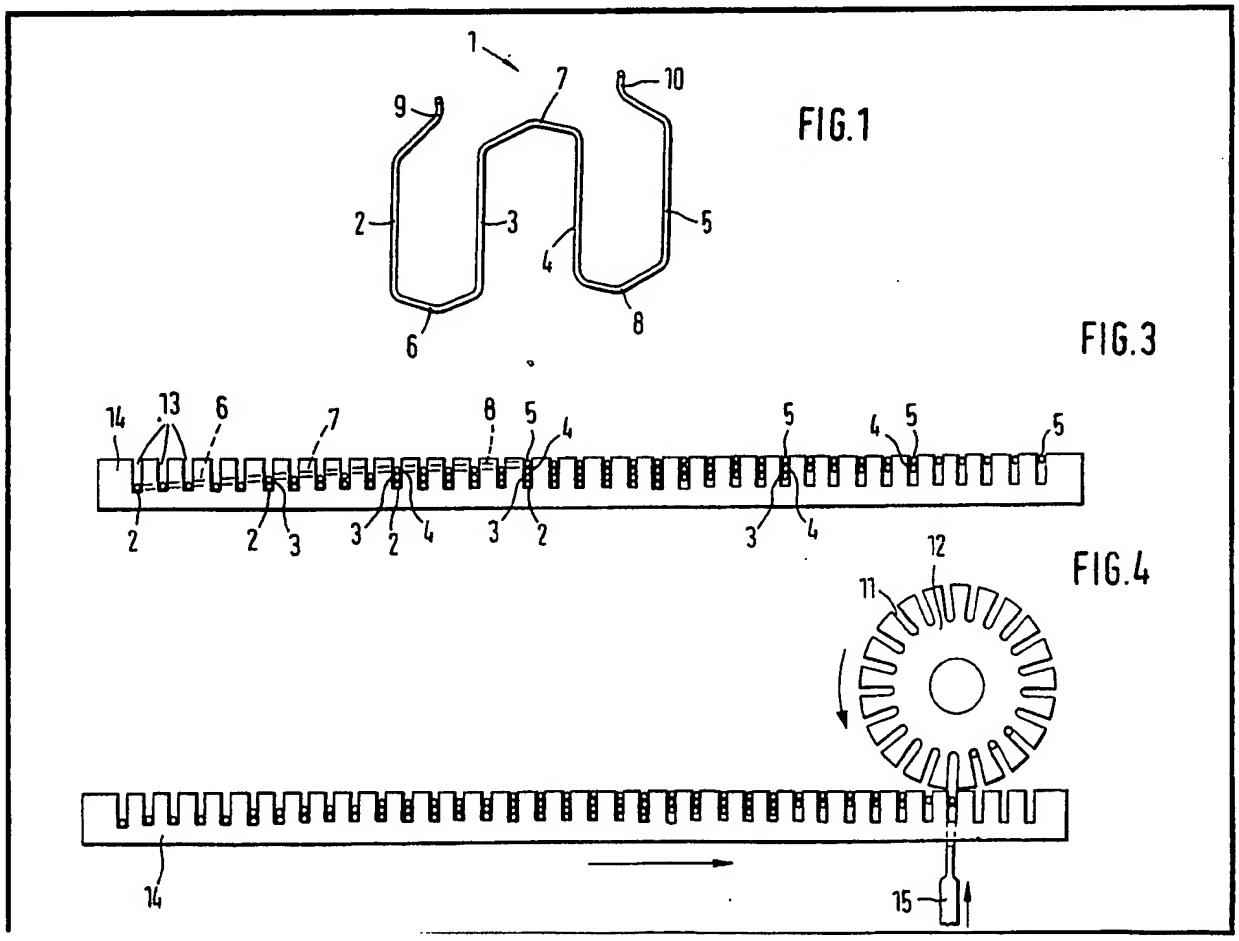


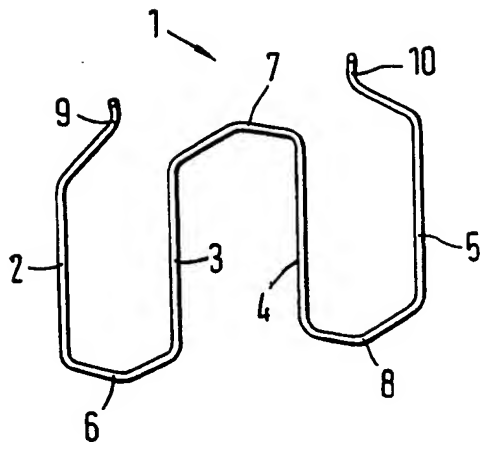
FIG.1

FIG.3

FIG.4

1/3.

FIG.1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7
10
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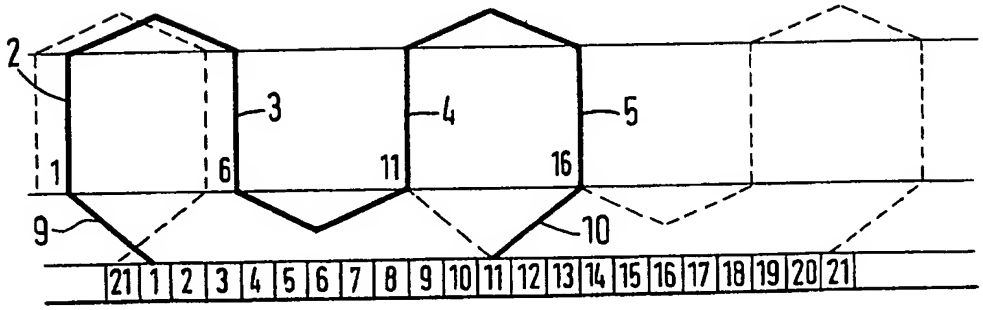
6

FIG.2


2
3
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11
16
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21 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

FIG.3

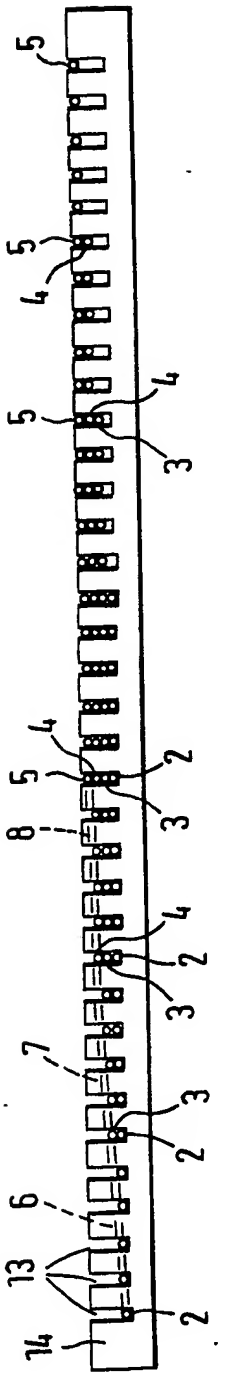


FIG.4

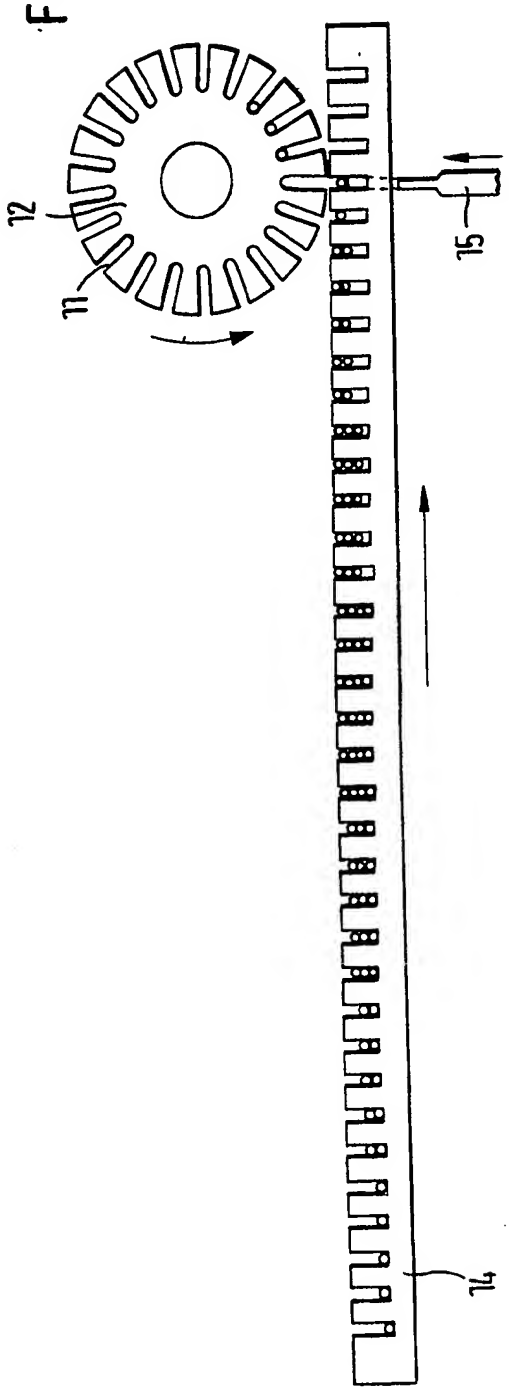
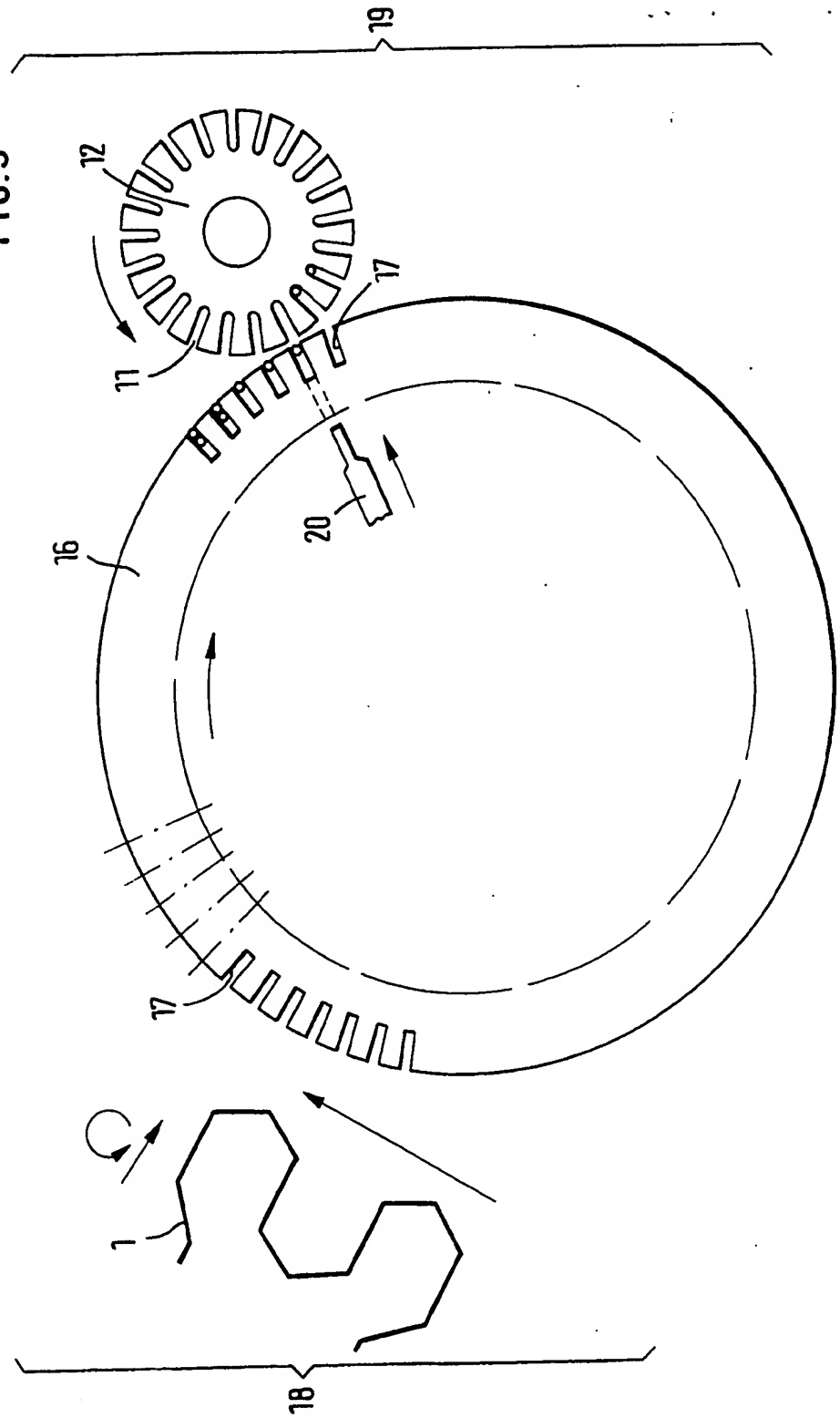


FIG.5



SPECIFICATION

Improvements in or relating to armature windings for direct current machines and apparatus for mounting windings on armatures

The invention relates to armature windings for direct current machines and apparatus for mounting windings on armatures.

Armature windings for direct current machines are customarily in the form of wire armature windings which are manufactured as manually-wound windings or plaited windings and/or mechanically as preformed windings or by the shuttle-winding method. In all these armature windings, the individual winding elements are formed in loops and are guided back into the starting slot in conformity with the winding step. It is thereby disadvantageous that unnecessarily long overhangs are produced, this being uneconomical particularly in the case of mass production. Furthermore, the expensive mechanical winding is unprofitable when manufacturing only medium numbers of armatures, and manual winding is also unprofitable.

According to one feature of the present invention there is provided an armature winding for a direct current machine in which a plurality of individual winding elements are introduced into slots in an armature and each winding element is of substantially meander-shaped construction and has at least four parallel straight portions which are inserted into the associated slots in the armature and which are interconnected by portions forming overhangs, one end of the first and one end of the last straight portion of a winding element merging respectively into a start and an end of the winding element.

According to another feature of the present invention apparatus for receiving winding elements of an armature winding embodying the present invention for insertion into armature slots comprises a reception part provided with slots whose distance apart is at least equal to that of the armature slots which accommodate the parallel straight portions of the winding elements, the reception part slots being adapted to have the parallel straight portions of the winding elements inserted therein from the inside to the outside in the reverse sequence from that in which they are pushed from the reception part slots into the relevant armature slots.

An armature winding embodying the present invention, has the advantage that smaller, and thus material-saving, overhangs can be formed by virtue of the open winding elements, the favourable filling of the slots can be retained as in the known preformed winding principle, winding wires can be used which have a larger cross section than those used in the known mechanical method, and the winding elements are suitable for adaption to any degree of automation depending on the numbers of armatures to be manufactured.

It is particularly advantageous that armatures can be manufactured economically with low expenditure on tools, irrespective of the number of armatures to be manufactured.

The invention will be further described by way of example with reference to the accompanying drawings in which:—

Figure 1 shows an element of the armature winding,

Figure 2 is a diagram showing a method of winding the armature winding,

Figure 3 shows a bar serving as a reception member with winding elements for an armature winding inserted,

Figure 4 is a simplified illustration of a first embodiment of a device for introducing an armature winding into an armature, and

Figure 5 shows a second embodiment of a device for introducing armature windings into an armature, likewise illustrated in a simplified form.

A winding element 1 of an armature winding, which is in the form of a four-pole wave winding, is of substantially meander-shaped configuration. The winding element 1 has four parallel, straight portions 2, 3, 4, 5 which are interconnected by shorter angled portions 6, 7, 8. The free end of the winding portion 2 merges into the start 9 of the winding, and the end 10 of the winding element 1 is contiguous to the free end of the winding portion 5.

Instead of a closed preformed winding the open winding element 1 is introduced into slots 11 in an armature 12 of a known d.c. machine which is therefore not illustrated. Referring to the winding diagram shown in Fig. 2, for an armature having 21 slots, the straight portions 2 to 5 of the first winding element 1 are introduced into the 1st, 6th, 11th and 16th slots, and those of the second winding element 1 are introduced into the 2nd, 7th, 12th and 17th slots etc. The open shape of the meander-shaped winding element 1 and the spring action of the angled portions 6 to 8 facilitate the pressing-in of the winding element 1 into the slots 11 in the armature 12. Thus, the winding element 1 can be acted upon by smaller forces. This leads to simpler and less expensive devices and prevents damage to insulating slot linings and/or to the wire insulation of the winding element. Moreover, small and orderly overhangs which save winding wire and space can be obtained by virtue of the relative flat, angled portions 6 to 8.

For avoiding undue expense of mounting a winding on an armature, especially when only a relatively small number of armatures are being manufactured, a device as illustrated in a simplified form in Figs. 3 and 4 is suitable for mounting the winding on the armature 12

at the same time rendering it possible to mount the winding on the armature automatically and inexpensively. The winding elements 1 for an armature winding, which are to be introduced into an armature 12 having for example twenty-one slots 11 are introduced into thirty-six slots 13 in a reception bar or bars 14, acting as a magazine, in the reverse sequence to that in which they are to be inserted into slots 11 of the armature from the inside to the outside. The portion 2 of the 1st winding element 1 then lies on the bottom of the 1st slot 13 of the reception bar 14. When introduced into the armature slot 11, it will form the outermost layer of a four part winding, in the 1st armature slot 11. The portion 3 of the 1st winding element 1 lies as the second bottommost in the 6th slot 13 of the reception bar 14. Introduced into the 6th slot 11 of the armature 12, it lies as the second outermost layer. The portion 4 of the 1st winding element 1 lies in the 11th slot 13 of the reception bar 14 on top of two previously introduced winding portions 2 and 3 of the 11th and 6th winding element 1 respectively. It forms the second innermost layer in the 11th armature slot 11. The portion 5 lies uppermost in the 16th slot 13 of the reception bar 14 into which the portion 4 of the 6th winding element 1, portion 3 of the 11th winding element 1, and portion 2 of the 16th winding element 1 have previously been introduced. Consequently the portion 5 of the 1st winding element 1 will lie at the bottom of the 16th slot 11 of the armature 12 as the innermost winding in the 16th armature slot 11. The other winding elements 1 are each introduced into the reception bar 14 so as to be staggered by one slot 13. From the 22nd slot onwards, the number of winding portions 2 to 5 which is introduced into the following slots 13 again decreases. The armature windings arranged in the reception bar 14 can be readily stacked and introduced into devices by means of which the windings are pressed out of the reception bar 14 into the slots 11 of the armature 12. For this purpose, a reception bar 14 containing an armature winding is guided past a rotating armature 12 and the winding portions accommodated in a slot 13 are pushed by a plunger 15 into the armature slot 11 which comes into register with that slot 13. The 1st armature slot 11 then arrives at the 22nd slot 13 in the reception bar 14 again, and the plunger 15 pushes the portions 5, 4 and 3 of the 7th, 12th and 17th winding elements 1 respectively onto the winding portion 2 of the 1st winding element 1 in the 1st armature slot. The plunger 15 finally pushes the portion 5 of the 21st winding element out of the 36th slot 13 into the 15th armature slot 11, so that four winding portions 2 to 5 have been introduced into each armature slot 11. Alternatively, the reception bar or bars 14 can be charged with more than one armature winding. When the windings are arranged one behind another for two or more armatures, the armatures are successively provided with the associated windings, and when the windings are arranged adjacent to one another, the armatures are simultaneously provided with the associated windings.

When relatively larger numbers of armatures are being manufactured it is economical to use a device in which the armature windings can be continuously received and pressed into the armature slots. A second embodiment of a device for mounting an armature winding in armature slots is illustrated in Fig. 5 and has a circular plate 16 serving as a reception part. The rim of the circular plate 16 incorporates slots 17 into which winding elements 1 are continuously inserted one after another in an insertion region 18. This can be effected automatically, and, in the case of an armature 12 having twenty-one slots 11, in the same sequence as that described above for the reception bar 14. The insertion region 18 comprises approximately one half of the circular plate 16. The circular plate 16 is arranged so as to be rotatable. Its half provided with winding elements 1 is rotated into a transfer region 19 into which the rotating armature 12 extends and in which a plunger 20 is arranged. The plunger 20 is reciprocated and presses the respective winding portions 2 to 5 out of a slot 17 into the oppositely located armature slot 11. The circular plate 16 is again rotated into the insertion region 18 where it is again charged. The armature winding then introduced into the slots 17 in the circular plate 16 is subsequently pressed into the next rotating armature 12 which in the meantime has been brought into the transfer region, while the circular plate 16 has also further rotated.

CLAIMS

1. An armature winding for a direct current machine, in which a plurality of individual winding elements are introduced into slots in an armature, and each winding element is of substantially meander-shaped construction and has at least four parallel straight portions which are inserted into the associated slots in the armature and which are interconnected by portions forming overhangs, one end of the first and one end of the last straight portion of a winding element merging respectively into a start and an end of the winding element.

2. Apparatus for receiving winding elements of an armature winding as claimed in claim 1 for insertion into armature slots, comprising a reception part provided with slots whose distance apart is at least equal to that of the armature slots which accommodate the parallel straight portions of the winding elements, the reception part slots being adapted to have the parallel straight portions of the

winding elements inserted therein from the inside to the outside in the reverse sequence from that in which they are pushed from the reception part slots into the relevant armature.

3. Apparatus as claimed in claim 2, including means for establishing relative rotational movement between the armature and the reception part and a plunger arranged so as to be movable in the direction of the longitudinal axis of the slots in the reception part to push the parallel straight winding portions of the winding elements out of the reception part slots and into the associated armature slots.

4. Apparatus as claimed in claim 2 or 3, in which the reception part is in the form of a magazine-like bar whose slots accommodate the parallel straight portion of winding elements of at least one armature winding.

5. Apparatus as claimed in claim 2 or 3, in which the reception part is in the form of a circular plate whose slots are formed in the periphery thereof, and into which slots the parallel straight portions of the winding elements can be continuously inserted in one region and out of which slots the parallel straight portions of the winding elements can be continuously pushed into the associated slots in armatures in another region.

6. An armature winding for a direct current machine, constructed and arranged substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings.

7. Apparatus for forming a wound armature for a direct current machine, constructed and arranged and adapted to operate substantially as hereinbefore particularly described with reference to and as illustrated in Figs. 3 and 4 or Fig. 5 of the accompanying drawings.

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